Corresponding author
Prof. Dr. H.V. Klapdor-Kleingrothaus
Max-Planck-Institut für Kernphysik
Saupfercheckweg 1
D-69117 HEIDELBERG
GERMANY
Phone Office: +49-(0)6221-516-262
Fax: +49-(0)6221-516-540
email: klapdor@gustav.mpi-hd.mpg.de

'Naked' Crystals go Underground

H.V. Klapdor-Kleingrothaus [1]

Max-Planck-Institut für Kernphysik, PO 10 39 80, D-69029 Heidelberg, Germany

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On May 5, 2003 in the GRAN SASSO Underground Laboratory the first naked high-purity Germanium detectors were installed successfully in liquid nitrogen in the GENIUS-Test-Facility (GENIUS-TF) (Figs. 1, 2). This is the first time ever that this novel technique for extreme background reduction in searches for rare decays is going to be tested under realistic background conditions.

The team which achieved this consists of Hans Volker Klapdor-Kleingrothaus (Spokesman of the Heidelberg-Moscow experiment and also speaker of this collaboration), Oleg Chkvorets, Irina Krivosheina, Herbert Strecker and Claudia Tomei from the Max Planck Institute for Nuclear Physics in Heidelberg (Fig. 3).

The naked crystals are sitting on a plate made from a special type of teflon, in a thin-walled copper box filled with 70 liters of highly purified nitrogen. The copper is thermally shielded by 20 cm of special low-level styropor, followed by a shield of 15 tons of electrolytic copper (10 cm), and 35 tons of lead (20 cm).

The total setup is being shielded by 10 cm of Boronpolyethylene as a neutron shield. A new digital data acquisition system allows to simultaneously measure

[1] Home-page: *http : //www.mpi − hd.mpg.de.non_acc/*

energy, pulse shapes, and other parameters of the individual events.

The four detectors, in total 10 kg of high-purity natural Germanium, have been tested in the day of installation already, with radioactive sources of ^{60}Co and ^{228}Th and show good energy resolution. A spectrum is shown in Fig. 4. It can be said already also that microphonics in the liquid nitrogen is not a problem.

The GENIUS-TF project of the HEIDELBERG group had been approved in Gran Sasso in early 2001 - after the first Germanium crystals used in liquid nitrogen for spectroscopy had been tested already in Heidelberg in 1997 (J. Hellmig and H.V. Klapdor-Kleingrothaus, Z. Phys.A 359 (1997) 351, H.V. Klapdor-Kleingrothaus, J. Hellmig and M. Hirsch, J. of Physics G, 24 (1998) 483, in connection with the proposal of GENIUS (CERN COURIER Dec. 1997, H.V. Klapdor-Kleingrothaus, Int. J. of Physics A 13 (1998) 3953).

GENIUS was proposed to look with extreme sensitivity for cold dark matter (CDM), double beta decay and low energy solar neutrinos.

With the successful start of operation of Ge detectors in liquid nitrogen in Gran Sasso a historical step has been achieved of a novel technique, and into a new domain of background reduction in underground physics in the search for rare events. Besides testing of constructional parameters for the GENIUS project, one of the first goals of GENIUS-TF will be to test the signal of cold dark matter reported by the DAMA collaboration a few years ago (Bernabei et al.) which could originate from modulation of the WIMP flux by the motion of the Earth relative to that of the Sun.

Hans Volker Klapdor-Kleingrothaus

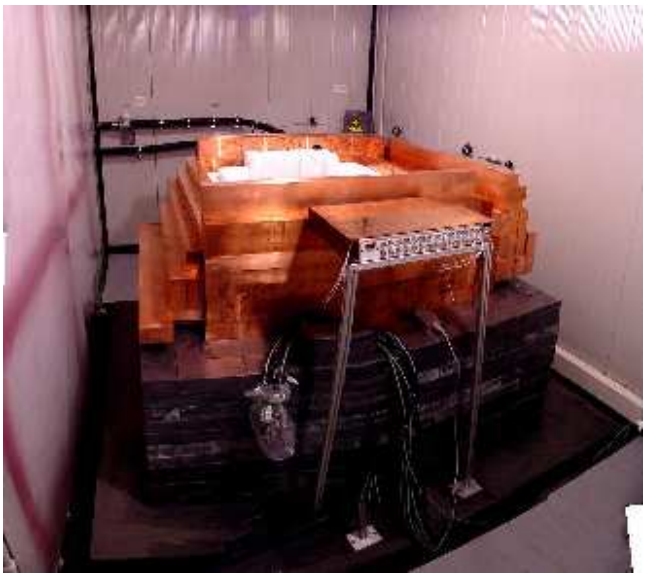

Fig. 1. View of GENIUS-TF in the Gran Sasso Underground Laboratory in Italy.

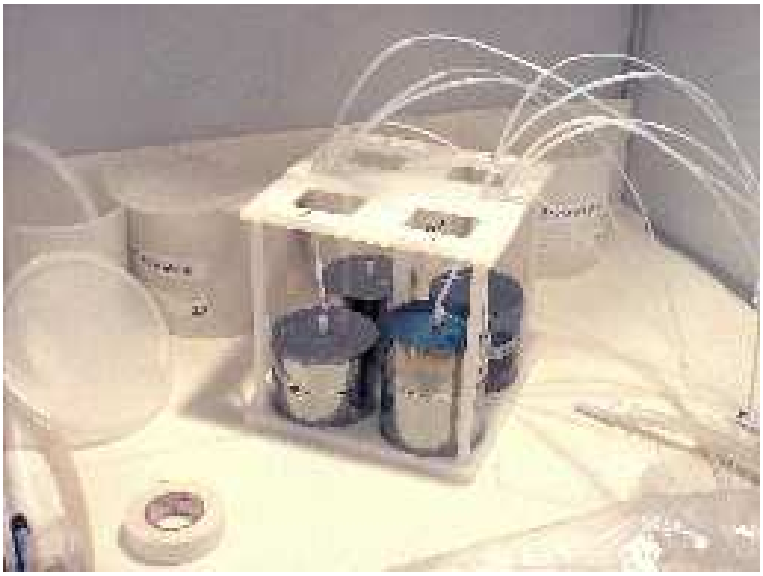

Fig. 2. The contacted four naked detectors in the low-level holder in which they are put into the shielded liquid nitrogen container of GENIUS-TF.

Fig. 3. The successful team after installation of the detectors, on May 5, 2003. From left to right: Irina Krivosheina, Hans Volker Klapdor-Kleingrothaus (Spokesman of the Heidelberg-Moscow experiment and also speaker of this collaboration), Oleg Chkvorets, Irina Krivosheina, Claudia Tomei and Herbert Strecker from the Max Planck Institute for Nuclear Physics in Heidelberg.

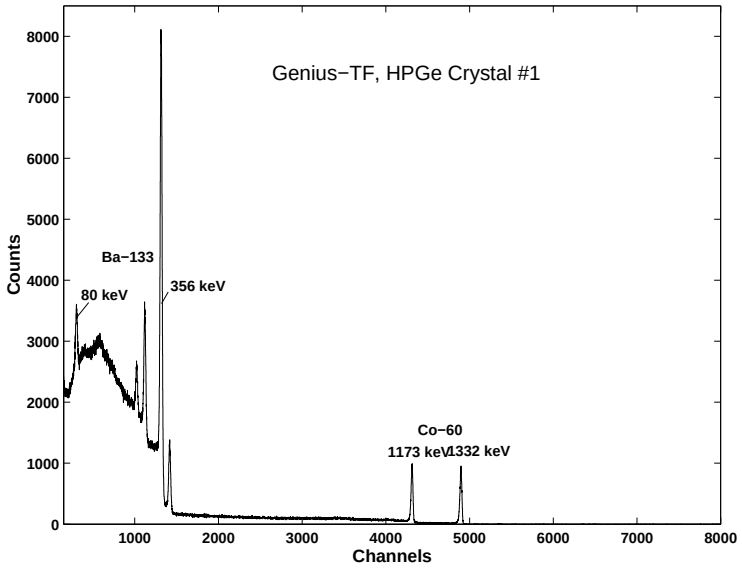

Fig. 4. Spectrum measured for one of the detectors with a ^{60}Co and a ^{133}Ba source. The other detectors show the same quality.